THE GEOGRAPHICAL DISTRIBUTION OF *PURPURA LAPILLUS* (L.). PART I: IN PALÆARCTIC WATERS.

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It seems possible that investigation into the geographical distribution of some of our common littoral species may produce results of scientific value. The present paper on the distribution of *Purpura lapillus* (L.) is offered as a first contribution towards this kind of knowledge.

One preliminary remark may be made. The facts of geographical distribution may be established partly by positive, partly by negative evidence. Negative evidence as to distribution, in the case of a common species of wide extent, naturally operates at the extreme termini of its range, north or south, east or west, as the case may be. In the range of the species under investigation—and equally in the case of all littoral species occurring on the west coasts of Europe—negative evidence, by establishing the fact that it has not been found north or south of certain points, will warrant the conclusion that the northern and southern limits of its distribution have been at least provisionally arrived at.

No attempt has been made in this paper to deal with questions of synonymy, or to discuss the causes of variation.

We begin with the far north, in North-West Siberia. *P. lapillus* does not occur at the mouth of the Yenesei River, not having been found there by the Russian expedition sent in 1866 to investigate the corpse of a mammoth (Schmidt **107**), or by Nordenskiöld's *Vega* Expedition of 1875–6 (Leche **65**). It is not found in the Kara Sea (Collin **17**, Pfeffer **98**, Herzenstein **44**, Dautzenberg & Fischer, Voyage of the *Belgica*, 1907, **25**, Voyages of the *Hirondelle* and *Princess Alice*, 1898–1907, **27**), nor did the Andrew Coats cruise of 1898 find it at Kolguev Island (Melvill & Standen **81**). It does not occur in Franz Josef's Land (Melvill & Standen **81**, Jackson Harmsworth Expedition of 1896–7). Frequent expeditions to Spitzbergen have failed to detect it (Torell **117**, Mörch **87**, McAndrew, Phipps, & Leach **76**, Jeffreys **54**, Friele **37**, Hägg, Swedish Polar Expedition of 1900, **41**, Krause **61**, Pfeffer **99**), and Knipovitsch does not include it in his exhaustive *résumé* of the molluscan fauna of the island (**58**). Neither Friele (**36**), dealing with the Mollusca of the Norwegian North Atlantic Expedition of 1877, nor Becher (**9***a*), nor Hägg (**41**), record it from Jan Mayen Island. There appears to be no record of collectors from Bear Island.

The most northern occurrence of the species is in Novaya Zemlya, where it was "captured at the shore of the Matotschin-shar" (or Matthew Strait, which cuts the great island in two) by the *Willem Barents* Dutch Expedition of 1878–9 (van Lidth de Jeude **67**). The specimens, which belonged to the var. *imbricata*, Lam., were

placed in the Leyden Museum, and have since, I am assured by Dr. J. Vernhout, been unfortunately lost. It was not brought from the northern part of Novaya Zemlya in the collections made by Ivanoff (Dautzenberg **24**), nor by the Mission Bénard in 1908 (Dautzenberg & Fischer **26**), this latter expedition being mainly concerned with dredging work. Nor was it found by the *Isbjörn* in 1879, which dredged in very shallow water, but did no shore collecting (Smith **109***a*). The *Belgica* (Dautzenberg & Fischer **25**) went through the Matotschin Schar in 1907, but did not stay to do any shore collecting, and the *Vega* Expedition of 1875–6 (Leche **65**) dredged near the straits, but did not pass through them. The *Djumphna* (Collin **17**) in 1882–3 visited several points in South-West Novaya Zemlya, but does not seem to have done any shore collecting.

Middendorff (**82**) states that he brought home specimens of *P. lapillus* from the White Sea, and is confirmed by Herzenstein (**43**), a much later authority. On the other hand, Professor N. Nasonov, the Director of the Zoological Museum, Imperial Academy of Sciences, St. Petersburg, writing to me, quotes the view of Dr. Knipovitsch: "Selon son opinion, la *Purpura lapillus* ne se rencontre nullement . . . dans la Mer Blanche même." Both views are possible. The northern limits of the White Sea are defined by Herzenstein (**43**) by a line drawn from Cape Kanin in the east to Swyatoi Noss (or Holy Cape) in the west. Within this line falls the most easterly point on the mainland of Northern Europe and Asia on which *P. lapillus* has hitherto been found,[1] viz. Trechostrow or Tri Ostrova (Three Islands), in 67° N. 40° E., near the mouth of the Ponoi River. On the other hand, it is quite possible to define the White Sea proper by a line drawn much further south, in the narrow neck, in which case Tri Ostrova falls outside the limits of the White Sea. Knipovitsch, in his memoir on the fauna of the Solovetsky Islands (**57**), does not mention *P. lapillus*.

The fact that *P. lapillus* occurs on the west coast of Novaya Zemlya, in 73° 20′ N., and not in the interior of the White Sea, the main body of which lies between 66° N. and 64° N., well to the south of the Arctic Circle, is due to obvious causes. The water on the west coast of Novaya Zemlya is no doubt affected by the flow of the Gulf Stream past the northern coast of Norway, which raises its temperature to about 40° F. in the month of August. The White Sea is uninfluenced by any current of warm water; it is beset with ice for many months of the year, and its temperature, both at the surface, and at depths of 10, 40, and 75 fathoms, is known to be remarkably low (Herzenstein **43**). Novaya Zemlya acts as an effectual barrier to the eastward advancement of any warm current, and the fauna of the Kara Sea, and no doubt of the eastern coast of Novaya Zemlya itself, is of an Arctic type.

[1] My authority is a letter from Professor Nasonov: "Le feu M. Herzenstein n'a rencontré cette forme qu'à Tri-Ostrova, c'est à dire à l'entrée-même de la Mer Blanche."

All along the Mourmane coast as far as the Varanger Fiord, *P. lapillus* occurs in suitable localities, where it is quite common. Specially may be particularized: Gavrilovo (69° 20′ N., 36° E.), Lodenaia, Teriberka (69° 20′ N., 35° 10′ E.), the port and island of Jekaterinskaia Gavang in the Kola Fiord (all in Coll. A. H. C.). Pfeffer (**99**) records it from Ieretik Islands, Port Wladimir (69° 40′ N.), and the Mourmane coast generally. In East Finmark it is recorded from Vadsö in the Varanger Fiord (Norman **91**, de Guerne **29**, Coll. A. H. C.), with the var. *imbricata*, Lam., and in North Finmark from the Porsanger Fiord (Friele **38**, Coll. A. H. C.).

The general facies of many specimens from the extreme north is very characteristic, and would amply warrant those who are fond of naming varieties in applying to them the name of var. *borealis*. The shell is comparatively thin, long and rather narrow, spire elevated, mouth very long oval, outer lip scarcely at all thickened, sculpture a number of raised concentric rings, which in some cases tend to disappear altogether, colour light to very dark brown. The extreme form of this variety occurs in the Kola Fiord and on the Mourmane coast; specimens from Vadsö and the Porsanger Fiord are similar in shape and more compact in structure. The same form of shell occurs in North-West Norway at Tromsö (Coll. A. H. C.) and at least as far south as Lödingen (68° 30′ N.), where it is much more massive and solid, one specimen measuring over 1·625 in. in length.

P. lapillus is common on the Norwegian coasts from the North Cape (M. Sars **106**, Lovén **72**) to the Naze, and exhibits many of the same variations of form which are to be observed on our own coasts. Specimens from Trondhjem recall a form from Newquay or South Wales, from Aalesund a form common on the West of Scotland, from Finsnes a form from Loch Swilly. It is noted from the Lofoden Islands (G. O. Sars **105**) and from Bergen (Lamy **64**), and is found in every suitable locality on the northern shores of the Skager Rak up to the outer waters of the Christiania Fiord, becoming more scarce as we move north. Asbjörnsen (**5**) distinctly states that it is not found in the narrow waters of the fiord, but only in the open sea, naming such places as Randoer, Bollaererne, and Faerder Islands, where it occurs, seldom living, at a depth of 10–20 fathoms. Jeffreys (**52**), for instance, did not get it at Dröbak. On the south-west coast of Sweden, Malm (**79**) records it from the Vaderö Islands, and, with Théel (**116**), also from Christineberg, on the western shore of Bläbergsholm, in Bohuslän. But a very short distance further south it becomes scarce, and Malm (**80**) records that near Göteborg it occurs only on the outer side of Vinga Islands, where it was so rare that he was only able to collect one single living specimen, but in the trawl he got a few dead shells. The British Museum possesses two specimens labelled "Coast of Sweden", which were dredged by Dr. Thuden and presented by him on October 13th, 1863. The shells are small, not quite mature, the largest measuring ·875 inch in length, surface slightly imbricate, concentrically corded with raised lines, spire prominent, colour dirty white.

In the Southern Kattegat, Lilljeborg (**68**) recorded *P. lapillus* from

the Kullen Peninsula. It may be doubted whether the record can stand. Professor Ad. S. Jensen, after remarking that Helsingborg and Kullen were named as localities by Lovén and Oersted, says, in a letter to me: "In all probability the statements refer to semi-fossil specimens from the (query ?) *Tapes* or *Littorina* period. It does not live in the inner Danish seas (the Great and Little Belt and the Baltic)." No writer on Baltic Mollusca has ever recorded it.

On all the mainland coasts of Denmark *P. lapillus* scarcely occurs. Christensen (**5**) says: "*P. lapillus* is very rare, and apparently only locally in the north; thus it appears at Hirtsals, where the bottom is full of stones." Mörch (**88**) mentions the following localities: Hornaes, Skagen, and between Skagen and Hirtschals, common at Hirtschals (Majborg); Frederikshavn (Steenstrup). To quote again from Professor Jensen's letter: "The only place in which it has been found with certainty living is the northern part of the west coast of Jutland (Hirshals, Blockhus). From old time there is in our museum [at Copenhagen] a specimen (with animal) which is said to have been taken at Frederikshavn (east coast of Jutland), but in modern time no living specimen has been found there. C. G. Johs. Petersen records a 'recently dead' shell at Gerrild Klint, near Grenaa, on the east coast of Jutland." By the courtesy of the Professor I possess two specimens from Hirtschals. They are labelled "from the mole: C.G. Johs. Petersen leg. 1889", and represent a short stout type of shell common in Britain. I have also a specimen labelled "fossil from the *Dosinia* beds (the last stage of the warm *Litorina*-time), near Frederikshavn, Jutland; V. Nordman leg. 1904".

Collin (**16**) reports that *P. lapillus* does not now live in the Lim Fiord, which runs through Denmark, from the Kattegat to the North Sea. He found two dead but recent specimens in Odde Sound, but they were probably introduced from the North Sea by fishing gear. The species occurs sub-fossil at several places on the fiord. The sandy west coast of Denmark does not offer many suitable localities for the species.

Frey and Leuckart (**35**) record it from Heligoland. From Holland I have specimens, in no way remarkable, from Domberg, Walcheren Island, at the mouth of the Scheldt.

On the Belgian coast the species no doubt occurs in all suitable localities. Lameere (**63**) and Gilson (**39**) both place it in their list of the marine fauna of Belgium, and Pelseneer (**96**) has it from Blankenberghe.

The range of *P. lapillus* in Iceland is strictly confined to the warm west and south coasts; on the colder east and north it is not found living, though Bardáson records it in a fossil state from some of the northern fiords, deducing from the fact a higher temperature for those shores during the corresponding geological period (Odhner **92**). No better illustration could be found of the fact that the absence of a current of warm water tends to cut off the range of certain species. *P. lapillus* occurs all round the North Cape and Mourmane coast, many miles north of the Arctic Circle, and even as far north as Novaya Zemlya, and yet cannot exist in the cold area of the coasts of

Iceland, practically all of which island lies south of the Arctic Circle. The surface temperature of the water on the north coast of Iceland appears never to rise above 41° F., while in winter it sinks to 32°; the water on the south-west of Iceland is never colder than about 40°, and in summer rises to between 50° and 60° F.

Mohr (**89**), G. O. Sars (**105**), Verkrüzen (**119**), Johansen (**55**), all record the occurrence of the species in Iceland. My collection contains specimens from Reykjavik, the Islands of Vithey, Hafnafiord, Stykkisholmr, and Flatey Island in the Breidifiord, Dyrafiord in the extreme north-west, as well as from two places not marked in my maps, Skerjafiord (1½ to 2 fathoms, sandy bottom, A. C. Johansen) and Heymaey (A. C. J.). In form the specimens vary greatly, some being stout and thick-lipped, and recalling forms from our own coasts, some (from Reykjavik) thin-lipped and rather degenerate, colour a peculiar slaty-grey, interior strongly iridescent, others, from the Breidifiord, resemble a form from Vadsö, while those from the Dyrafiord, the furthest north, closely recall a form described above from the Mourmane coast.

Specimens from the Faroe are large and very solid: the broadly banded form also occurs there (Coll. A. H. C.). The species is in Mörch's catalogue (**86**).

In the British Islands, which appear to be the metropolis of this species, it occurs in abundance in every form of coast on which it can find a lodgment.

Locard (**71**) gives the following comprehensive list of French localities:—English Channel: Dunquerque (Le Nord); Wimereux, le Boulonnais (Pas de Calais); Dieppe, Fécamp (Seine Inf.); Normandy; Langrune, Granville (Calvados); Cherbourg, Valogne (La Manche); St. Malo, Cancale (Ille et Vilaine). Atlantic Ocean: Armorican and Aquitanian regions: Brest, Roscoff (Finistère); Impairs, Ponliquen, Ker Cabalec, Pornichet (Loire Inf.); Ile d'Yeu, Sables d'Olonne (La Vendée); La Rochelle, Royan, Ile de Ré (Charente Inf.); Cordouan, Vieux Soulac (Gironde); St. Jean de Luz (Basses Pyrénées). The var. *imbricata*, Lam., is given by the same author as occurring at many places from Dunkirk to Royan. In reviewing a collection from French localities one is struck by the marked declination in size of shell as compared with specimens from our own shores, and this is particularly the case with specimens from the Atlantic coasts. Shells are massive and well formed, but they do not appear to approach ours in length. The var. *imbricata* seems to be relatively abundant.

On the northern coasts of Spain, *P. lapillus* is recorded from Santander, San Vincente de la Barquera, and Gijon (Hidalgo **45**, **47**), from Asturias and Galicia generally (McAndrew **74**), from Rio de Betanzos and Corunna (Hidalgo **45** and McAndrew and Woodward **78**), from Vigo (Hidalgo **45** and McAndrew **74**, **75**), from Caramelas, Bayona, and all Galicia from the frontier of Portugal to Rivadeo (Hidalgo **46**).

In Portugal *P. lapillus* is fairly abundant on the rocks of the northern coast. In the west, it is common only on the rocks of Vianna do Castello, at the mouth of the River Limia in Minho, and

northward as far as the frontier. It is rather rare on the coast of Oporto, and becomes scarce towards the south (Nobre **90**). There are specimens in the Oporto Museum from Foz do Douro and Leça da Palmeira (Anon. **3**). Nobre found one worn example at Portimão, 25 miles E.N.E. of Cape St. Vincent, in Algarve, N. lat. 37° 10′. In my collection, from the same spot, are included a number of specimens collected by Dr. H. Gadow "at a small rock near the harbour entrance". "Thence eastward," continues Dr. Gadow in a private letter, "e.g. Faro and Oldhão, the coast is sandy, flat, and with lagoons of muddy bottom, or protected by sandbanks; the same unsuitable conditions extend right up to Cadiz. West of Portimão, round Cape St. Vincent, the coast is rocky and suitable."

At Cadiz the species does not occur. It is not found in the lists of Cadiz Mollusca by Hidalgo (**48**) and Maxwell Smith (**110**), and I have collected there myself without finding it. Nor does it appear to occur at Tangier, where the shore conditions are wholly suitable. It seems reasonable, therefore, to conclude that Portimão in Algarve is the southern limit of the distribution of this species. Specimens from this locality are dwarfed but compact, mostly rich chocolate to brown, or blue-grey throughout, sometimes banded with white, mouth large, last whorl very large in proportion to rest of shell, sculpture none, or a few indistinct concentric rings. My largest specimen measures no more than ·8 in. in length.

P. lapillus has been occasionally, but, it would appear, mistakenly reported from the Mediterranean. Locard (**71**) remarks: "Le *P. lapillus* est indiqué dans la Méditerrannée à Nice par Risso et à Cannes par M. Dautzenberg. Mais M. de Monterosato (Conch. Medit., art. prin., p. 4) met en doute cette assertion." Hidalgo (**45**) notes: "? Minorca (Ramis)." Weinkauff (**123**) does not include it in his list. Kobelt (**59**) and G. O. Sars (**105**) omit the Mediterranean in their list of localities.

R. T. Lowe (**73**) includes *P. lapillus* in "A list of the shells observed . . . at Mogador . . . in April, 1859". After referring to the fact that Adanson (**2**) in his History of Senegal includes *P. lapillus* in his list, Lowe continues: "The abundant occurrence of a dwarf state or variety of this shell at Mogador renders it not at all improbable that it may be also found still further down the coast, and therefore possibly in Senegal. Fresh observations to decide this point would therefore be extremely interesting." M. Paul Pallary has the credit of resolving what would otherwise have been the inexplicable difficulty, that *P. lapillus* should occur at Mogador, more than 400 miles south of its southernmost European locality, without at the same time occurring on the intervening coasts. No search along the Moroccan shores has revealed the presence of *P. lapillus*, although they are in many places favourable for its occurrence. There can be little doubt that the shell described by M. Pallary (**95**) as *Ocinebrina purpuroidea* is the so-called dwarf form of *P. lapillus*, said by Mr. Lowe to be common at Mogador. The species, which might easily be mistaken for a small *Purpura*, occurs also at Rabat and Tangier. I noticed a single specimen in the McAndrew Collection

in the British Museum, from Santa Cruz, Canaries, on a tablet labelled "*Purpura*?", at the back of which Jeffreys had written in pencil "Not *Purpura*".[1]

Adanson's "Le Sadot" is *P. lapillus*. He not only figures the species himself, but makes reference to figures of Lister's "Buccinum Anglicum". "J'ai observé," he continues, "ce coquillage dans le port de l'Orient, à l'île de Ténérif des Canaries, à celle de Fayal, l'une des Asores; et je sçai qu'elle se trouve fréquemment sur toutes les côtes de la Bretagne." It is curious that he never definitely states that he has seen specimens from Senegal. But there can be no reasonable doubt that he was mistaken in regarding it as an inhabitant of that coast, or of the Canaries or Azores.

Mr. Tomlin has kindly given me two specimens of *P. lapillus* ex Coll. Watson, taken at Grand Canary. I have seldom seen shells more beach-worn. They must be considered as 'ballast' specimens. No writer for 150 years has recorded the species as living in the Atlantic islands.

I owe to Mr. Tomlin three other specimens, also ex Coll. Watson, from Madeira, no doubt the actual specimens to which Watson (**122**) refers when he places *P. lapillus* in a list of species "dredged by me or brought to me as Madeiran, but which I reject".

On the strength of two specimens of unknown locality from the Cape, Krauss (**62**) allowed himself to include *P. lapillus* in his list of South African marine Mollusca. G. B. Sowerby (**112**) has "received no confirmation of its living there".

M. Sars (**106**), G. O. Sars (**105**), and Pfeffer (**98**) give Behring's Sea as a locality for *P. lapillus*, but not on the authority of their own collecting. Crosse (**19**), cataloguing (after Dall **20**) the Mollusca of Behring's Strait and the neighbouring parts of the Arctic Ocean, records no other *Purpura* but *canaliculata*, Duel., from Plover Bay, Norton Sound, and the Aleutian Islands. Krause (**60**), whose collecting was chiefly done on the Tschuktschen Peninsula, in the far north of the Gulf of Anadyr, found no *Purpura* in Behring's Sea. In the Pribiloff and Commander Islands, Behring's Sea, Dall (**23**) found only *P. lima*, Mart., a form with which *canaliculata*, Duel., is identical.

Middendorff, both in his Beiträge and Reise (**82**, **83**), gives *P. lapillus* from the Sea of Ochotsk, and mentions the islands of Sitcha and Urup (in the Kuriles) as further localities. He says that in the Sea of Ochotsk it is rare, the majority of examples being rather thin, and he describes a form intermediate between *lapillus* and *freycinetii*, Desh.

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[1] Search among Lowe's Mogador shells in the Natural History Museum failed to reveal his specimens of '*P. lapillus*'. But Mr. Tomlin has placed in my hands a box labelled in R. B. Watson's hand "*Pisania*, Mogador". It contains numerous examples of *Ocinebrina purpuroidea*, Pallary. When one knows that many, if not most, of Lowe's marine shells passed into Watson's possession, it appears extremely probable that we have here the actual specimens which Lowe took at Mogador, and mistook for a "dwarf state of *P. lapillus*".

When we come to detailed investigation of the Japanese seas, there is still less evidence for the occurrence of *P. lapillus* in Far Eastern waters. Schrenck, Reisen in Amur Lande (**108**), omits it from his list; Lischke (**70**) does the same. Pilsbry's (**100**) catalogue admits it only on the authority of Stearns from Hakodate, and of E. A. Smith (below). A. Adams (**1**) mentions *P. lapillus* from different points in Japanese seas, from Saghalien southward, but when we find that he includes in his synonymy *freycinetii*, Desh., *attenuata*, Reeve (?), *analoga*, Forbes, and *squamosa*, Lam., his evidence ceases to possess value. E. A. Smith (**109**) included *P. lapillus* in a list of Gastropoda brought from Japan by Commander St. John, R.N., remarking that "the Japanese forms of this Protean shell are as varied as those in European seas". The actual specimens are in the British Museum, and undoubtedly belong to *freycinetii*, Desh.

The truth appears to be that there is no reason to believe that the species which we call *lapillus*, L., occurs in any part of Eastern Asia or North-West America. All the specimens from these seas hitherto referred to *lapillus* belong either to *freycinetii*, Desh., or to one or other of the West American *Purpuræ* which will be mentioned below. It is quite conceivable that a relationship, more or less close, exists between these groups and *lapillus*. When Northern Asia enjoyed a milder climate, opportunity would be given for the passage of littoral forms from the North Atlantic to the North Pacific, and vice versa. This may be held sufficient to account for the presence of closely allied, or even of identical species, in both these areas at the present day. Even as it is, experts find it no easy matter to distinguish between *lapillus* and certain forms of *freycinetii*, and between certain forms of *saxicola*, Val., and *lapillus*. Middendorff goes so far as to remark: "It can hardly fail to be the case that on the coasts of the North American Ice Sea passage-forms between *P. lapillus* and *P. freycinetii* will be found in the future." But a sufficient time seems to have elapsed since the passage via Northern Asia was closed for the forms on both sides to harden into what we agree to call species, just as we find a number of 'homologous forms' on the two sides of the Isthmus of Panama.

Aurivillius (**6**) distinguishes *freycinetii* from *lapillus* by the prominence of the last whorl and the great size of the mouth, but remarks on the similarity between certain forms of the two species. Middendorff speaks of the long aperture, short spire, and more impressed sculpture. Lischke particularizes, as points of difference, the narrowing of the mouth in front, running into a long canal, the strongly marked spiral ridges, the irregular longitudinal foldings on the upper part of the whorls. He thinks Adams' *lapillus* is *freycinetii*. Dunker (**32**) remarks that the description and figures of the type of *freycinetii* are so different from certain Japanese specimens which are before him, that he cannot believe they are *freycinetii*. Among the specimens are several which he cannot separate from certain varieties of *lapillus*, and accordingly he refers all his specimens to that species, confessing himself still ignorant what *freycinetii* is. The truth is, that, as Lischke has pointed out, Deshayes' type of *freycinetii* was

described from an extreme variety of this very variable shell.[1] Mr. G. Hirase, in whose catalogue of Japanese marine Mollusca *lapillus* finds no place, has supplied me with a sufficient number of specimens of *freycinetii* to illustrate the fact that *freycinetii* is nearly as variable as *lapillus* itself, and at the same time to establish the complete distinctness of the two species. Dunker's *P. leysiana* is a form of *freycinetii* in which the spiral ridges are deeply cut by longitudinal laminæ or foliations.

The geographical range of *freycinetii* appears to be as follows: Behring's Sea, Aleutian Islands, and Sea of Ochotsk (Middendorff); Kamschatka (Deshayes, Chiron, Schrenck); West Saghalien, Castries Bay, at Wjachtu and Dui, East Saghalien, at Manuë (Schrenck); Urup (Middendorff, as *lapillus*, L.); Etrup or Etorō, and Kunashiri in the Kurile Islands (Coll. A. H. C.); N. Yesso, at Teshiwo (as *saxicola*, Val., *teste* Pilsbry), Kushiro and Hidaka (Coll. A. H. C.); S. Yesso, Hakodate (Schrenck); N.E. Nippon, the southernmost locality I know (Stimpson). For some unexplained reason, *freycinetii* does not occur in Pilsbry's catalogue of Japanese marine Mollusca.

No satisfactory record exists of the occurrence of *P. lapillus* on any part of the west coast of North America. Cooper's *P. lapillus* is *emarginata*, Desh. (see p. 203).

Part II. In Nearctic Waters.

P. lapillus is recorded as an inhabitant of Greenland by Fabricius (**33**), Gould (**40**), Mörch (**85**), Möller (**85**), G. O. Sars (**105**), and others, the majority only repeating Fabricius' statement. According to Fabricius, "*Tritonium lapillus* habitat in littoribus arenosis: in Sinu Nerrutiksok dicto e regione boreali coloniæ Friderichshaab copiosum" (Friederikshavn is in about the latitude of South Iceland). Posselt (**101**) remarks that it appears to be found fairly locally, and that its possible range is from the extreme south to about 69° N. lat., at Jacobshavn, where he found one specimen. The majority of examples belong to the var. *imbricata*, Lam.

Drygalski (**31**), cataloguing the Mollusca of the Berlin expedition of 1891–3, did not find it at Karajak and Umanak Fiords, N. lat. 71°, nor was it found by H.M.S. *Valorous* in 1875 at Godhavn on Disco Island (Jeffreys). Professor Jensen writes to me: "The few specimens in our [Copenhagen] Museum have no distinct locality, only the collective name 'Greenland', and they are all from old days; in modern times the species has not been brought to us, and the last expeditions have seen nothing of this species, nor have I found it myself on my three journeys to Greenland. I have therefore some doubts regarding this species as an inhabitant of the present Greenlandic shores." It has never been recorded from East Greenland.

By the courtesy of Dr. J. Vernhout, I have had the opportunity of examining the Greenlandic specimens belonging to the 's Rijks

[1] Deshayes, in his description (Rev. Zool. 1839, p. 360; Mag. Zool., ser. II, i (Moll.), pl. xxvi, 2 figs., 1839), specially mentions the *arched* columella. His locality is Kamschatka.

Museum of Natural History, Leiden. The shell is fairly solid, well developed, not dwarfed; length 1·25 inch, breadth ·75; mouth ·75 long (to front end of canal), shape long oval; canal broad, well marked; outer lip simple, not denticled; sculpture, a number of strong transverse cords or blunt ridges, about eleven on the body-whorl, suddenly ceasing, to form a sort of shoulder, some way below the suture; colour dirty white.

The British Museum has three specimens, dated 23rd June, 1843, labelled "Greenland", purchased from Dr. Möller, and with a label attached in his handwriting. The shell is solid, strongly corded, spire prolonged, aperture orange-coloured, outer lip simple, scarcely thickened, specimens heavier and more solid than the Leiden shells. They closely resemble specimens from various parts of Scotland.

Considerable uncertainty appears to prevail with regard to the extreme northern range of *P. lapillus* on the east coast of North America. It is certainly not found in Northern Labrador; it does not occur in a list of Mollusca from Ungava Bay and the adjacent Arctic seas (Dall **21**). Hancock (**42**) did not find it on the west coast of Davis Strait. A catalogue of Mollusca dredged on the Labrador coast in 1882 (Bush **13**) does not contain it, though such common species as *Littorina rudis*, Mat., and *L. littorea*, L., are included. The coast referred to lies between N. lat. 52° 48′ and 51° 33′, and thus includes part of the Gulf of St. Lawrence. Nor does it occur in a list by Packard (**94**) of shells obtained while coasting from Little Meccatura Island, in the Gulf of St. Lawrence, to Hopedale (in N. lat. 55° 25′ on the East Labrador coast), and the same author (Packard **93**), publishing a list of dredgings, etc., near Caribou Island, at the entrance of the Straits of Belle Isle, remarks that the "entire absence of any specimens of *Purpura lapillus* was inexplicable, though I searched for that shell". In the more sheltered waters of the western portion of the Gulf of St. Lawrence, *P. lapillus* occurs e.g. at Gaspé, in New Brunswick, on stones near the shore (Dawson **28**), "on the whole coast below Little Metis, extremely common" (Bell **10**), and at Anticosti, not very common (Packard **93**), while Whiteaves (**125**) gives it in his list of marine Mollusca of East Canada, no doubt from this part of the gulf. It would thus appear that the whole of the East Labrador coast, and even the Canadian shores for some distance within the Straits of Belle Isle, offer no habitat for this species.

Verkrüzen (**121**) records a var. *ponderosa* from Notre Dame Bay in North Newfoundland (N. lat. 50°). If this approximates to the most northern point of its occurrence on the east coast of America, no better illustration could be afforded of the power of very cold water to bar back a species, for on the other side of the Atlantic the latitude of 50° just touches the Lizard. Accordingly Gould's (**40**) statement that *P. lapillus* "occurs on rocks everywhere from Greenland all through New England" will need some modification.

P. lapillus is extremely abundant on the northern coasts of Nova Scotia (Jones **56**); at Grand Manan, New Brunswick, a large chocolate-coloured form occurs (Dr. Gratacap). Verkrüzen (**120**) records it from Annapolis, and Nova Scotia in general. On the coasts

of Maine it is abundant (Stimpson **114**), e.g. at Eastport (Roper **103**), at Frenchman Bay (Blaney **12**), at North Haven (Jackson **50**), at Boston (Stearns **113**), where the var. *imbricata*, Lam., occurs. Ap-gar's (**4**) statement, that *P. lapillus* is abundant north of Cape Cod, local south of the cape, represents the facts exactly. At the point of Cape Cod it is found on the wharves at Provincetown (Winckley **127**, Rathburn **102**).

I am permitted to quote from a forthcoming work by Dr. Gratacap, curator of the Brooklyn Museum, the following localities south of Cape Cod: Nabsca Point, shores of Vineyard Sound, Cuttyhunk Island, and Watch Hill, Rhode Island. On the Connecticut coast the species becomes local at certain points only, and does not occur east of Stonington (Linsley **69**), which lies close to long. 72° W. and in N. lat. 41° 30′. On Long Island it is abundant only in the extreme north-east, at Montauk Point (Wheat **124**, Smith & Prime **111**), and is not recorded from any other place. This is its extreme southern range. Balch (**8**) does not give it in his list of the Mollusca of Coldspring Harbor, nor does Perkins (**97**) in his catalogue of New Haven Mollusca, and it does not even occur in Sanderson Smith's (**104**) catalogue of the Mollusca of Little Gull Island, which lies off Oyster Point, close to Montauk.

Through the courtesy of Mr. Wheat, I am informed that a dead specimen was once found at the Narrows on Staten Island, but this was probably introduced among "oyster seed" from Connecticut. Hubbard & Sanderson (**49**) do not include it in their catalogue of the Mollusca of Staten Island. Dall's locality "New Jersey" (Dall **22**) is not to be taken as implying that *P. lapillus* occurs on the shores of that State; "New Jersey" is merely his label, in the particular paper referred to, for a stretch of coast from New Jersey to Delaware and Long Island. Ford (**34**) does not include it in his list of the shells of the New Jersey coast. Letson (**66**) gives *P. lapillus* a place in his check-list of the Mollusca of New York, avowedly on the authority of De Kay (**30**). De Kay's authority becomes questionable when we observe his remark that *P. lapillus* "occurs along our coast from Cape Cod to Florida".

In conclusion, it will perhaps be interesting to direct attention to the extremely limited range of the species on the American coast, as compared with its extremely wide range on the eastern shores of the Atlantic. Leaving Greenland out of the question, the range of *P. lapillus* on the American mainland is no more than 10 degrees of latitude, from about N. lat. 51° to 41° 30′. In Europe, on the other hand, it extends from N. lat. 71° to 37°, or 34 degrees of latitude. Stated in miles, the range is in the one case about 690, in the other above 2,340. If we take in Greenland on the one hand and Novaya Zemlya on the other, the range in miles becomes 1,890 as compared with 2,480. On the American shore the northward range of the species is clearly restricted by the Labrador current, which flows steadily southward from the Polar basin throughout the year, and lowers the temperature of the water off East Canada, while the estuary of the St. Lawrence is blocked with ice for four or five

months. Its southward range is equally restricted by the influence of warm-water currents flowing northward from the Gulf of Mexico, and possibly also by the fact that south of Long Island the shore appears not very suitable for species requiring rocky lodgment.

That *P. lapillus* should be able to exist up to N. lat. 69° in Greenland, and unable to exist further north than about 51° in Labrador, is at first sight very remarkable, for, in other words, it occurs on the east of Davis Strait more than 1,200 miles north of its most northerly point on the west of that strait. But the western coast of Greenland has its climate softened by the influence of a warm southern drift from the Atlantic, which makes itself felt as far north as Baffin's Bay, and renders human habitation possible. The eastern shores of Greenland are swept by the ice-bearing Greenland current, flowing direct from the Polar basin.

Note on the Northern Group of West American Purpuræ.

This group exhibits, perhaps more than any other section of the genus, the tendency of *Purpura* to vary in shape, size, and sculpture. Some writers, e.g. Hemphill (Williamson **126**), regard all these forms as mere varieties of *P. lapillus*. But P. P. Carpenter (**14**, p. 148) long ago sufficiently distinguished the three species under which the different forms must fall, and more recent authors, e.g. Taylor (**115**) and Vanatta (**118**), agree with him in essentials.

Thus we have (only a selection from the synonymy is given)—

1. *lima*, Martyn, 1784, Univ. Conch., ii, fig. 46 (*Buccinum*).
   = *canaliculata*, Ducl., 1832, Ann. Sci. Nat., xxvi, p. 104, pl. i, fig. 1.
   = *decemcostata*, Midd., 1849, Beiträge Malac. Ross., pts. ii, iii, p. 116, pl. ix, figs. 1–3.
   + var. *attenuata*, Reeve, 1846, Conch. Icon., sp. 49, pl. x, fig. 49.
   + var. *analoga*, Forbes, 1850, P.Z.S., xviii, p. 273, pl. xi, fig. 12.
2. *plicata*, Martyn, 1784, Univ. Conch., ii, fig. 44 (*Buccinum*).
   = *lamellosa*, Gmelin, 1790, Systema, p. 3498, No. 173 (*Buccinum*).
   = *crispata*, Chem., 1795, Conch. Cab., xi, pp. 84–5, pl. clxxxvii, figs. 1802–3 (*Buccinum*).
   = *ferruginea*, Esch., 1829, Zool. Atlas, pt. ii, p. 10, pl. ix, fig. 2*a–b* (*Murex*).
   + var. *lactuca*, Esch., 1829, Zool. Atlas, pt. ii, pl. ix, fig. 3*a–b* (*Murex*).
   + var. *septentrionalis*, Reeve, 1846, Conch. Icon., sp. 50, pl. x, fig. 50.
3. *emarginata*, Desh., 1839, Rev. Zool., p. 360; Mag. Zool., ser. II, i (Moll.), pl. xxv, 2 figs., 1839.
   = *conradi*, Nutt. MSS.
   = *lapillus*, Cooper (*non* Linné).
   + var. *fuscata*, Forbes, 1850, P.Z.S., xviii, p. 274, pl. xi, fig. 13.
   ⇒ *saxicola*, auctt. (*non* Val.).
   + var. *ostrina*, Gould, 1852, Otia, p. 225 = Moll. U.S. Expl. Exped., Wilkes, xii, p. 244, fig. 310.

One of three specimens in the British Museum no doubt represents the type of *attenuata*, Reeve; no locality is marked, the shells are Cuming's. The form is closely allied to *canaliculata* (= *lima*), but is larger, broader, somewhat less solid, sculpture more conspicuously laminated, spiral ridges more numerous and smaller, shell without the deep 'channel' below the suture, which gives the name to *canaliculata*. No type of *analoga*, Forbes, seems to be preserved.

The type of *septentrionalis*, Reeve, is similarly represented in the British Museum by one of several specimens; the shell is massive, without flounces, and there is a variety with one broad white band on the body-whorl.

Vanatta (**118**) has pointed out—and he is undoubtedly right—that *P. saxicola* of Valenciennes (Voy. Vénus, Atlas, pl. viii, figs. 4, 4*a*) is a form of *freycinetii*, Desh. In the case of the *Vénus* Mollusca, there is no description to accompany the pictures in the Atlas. *Emarginata*, Desh., therefore becomes the type of the species, and the form hitherto represented by the name *saxicola*, Val., will become *fuscata*, Forbes. The type of *fuscata* is the larger of two specimens in the British Museum, collected by Captain Kellett and Lieutenant Wood, R.N., and erroneously said to come from the Sandwich Islands. The spire is elevated, and the spiral ridges well marked. The form *ostrina* has a low spire, with whorls almost or altogether destitute of spiral ridges.

Deshayes must have named his *emarginata* from a malformed specimen with a marked indentation in the outer lip, hence his name. He lays stress on this 'échancrure', which "corresponds to the second row of tubercles on the last whorl, and is comparable to the impression which the finger-nail might have left on the edge, had it been softened". His locality is "New Zealand", but there can be little doubt that his shell is the form which has been commonly recognized as *emarginata*.

As regards distribution, the *lima* group is found, in the far north, in Plover Bay, North-East Siberia, and Norton Sound, North-West Alaska (Dall **20**, as *canaliculata*), in the Pribiloff and Commander Islands, Behring's Sea (Dall **23**), and southward to Monterey (Berry **11**).

The *plicata* group extends from Sitcha and Kandjak Islands, Konyagen (Middendorff, as *Murex lactuca*) and Alaska (Coll. A. H. C.), through all British Columbia (Taylor **115**), to the neighbourhood of San Francisco, but apparently not so far south as Monterey (Berry **11**). I have a specimen from Hidaka, Yesso (Hirase).

The *emarginata* group extends from Ounalaska (Cooper **18**, as *saxicola*) to Margarita Bay, Lower California (Pease in Carpenter **14**, p. 152), in the form *ostrina*.

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